

REMARKS

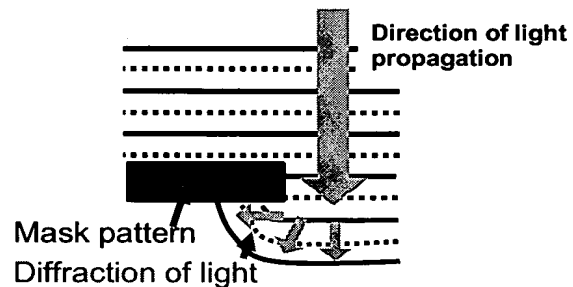
The Examiner's final Office Action of October 20, 2003 has been received and its contents reviewed. Applicant would like to thank the Examiner for the consideration and courtesies extended to the Applicants representatives during the personal interview on January 14, 2004. By the above amendments claims 9, 11, 16 and 17 have been amended, claims 10, 12-15, 18 and 19 have been canceled and new dependent claims 20-26 have been added. Support for the features of newly added claims 20-26 can be found at least in original Figures 1B-1C (claim 20), (Figures 1B, 4B (claims 21, 25), Figure 3C (claims 22, 26), and Figures 1B, 1C; page 24, line 17, to page 25, line 12, of the specification (claims 23 and 24). Accordingly, claims 9, 11, 16, 17 and 20-26 remain pending with claims 9 and 16 being independent. In light of the above amendments and for the reasons set forth below, the Applicant requests that reconsideration be given to the above-identified application.

With regard to the Examiner's holding that the Group I - claims 9-13 (drawn to a photomask set) are directed to an invention which is separate and distinct from that of the Group II - claims 14-19 (drawn to a method of aligning employing the photomask set of claim 9-13), the Applicant points out that the instant amendment clearly sets forth that the two-photomask set of Group I is employed in the method of use of the photomask set forth in Group II. Accordingly, it is respectfully requested that non-elected Group I claims 9, 11 and 20-22 be maintained in the present application, pursuant to MPEP Chapter 821.04, for purposes of rejoinder upon the Group II claims 16, 17 and 23-26 being found allowable.

Referring now to the Office Action, claims 14-19 are rejected under 35 U.S.C. §103(a) as unpatentable over either one of Hwang (U.S. Patent No. 6,063,529) or Ando et al. (U.S. Patent No. 5,989,759 – hereafter Endo) in combination with one of ordinary skill in the requisite art's ability. In response to this rejection, the Applicant has amended independent claim 16 (and independent claim 9 of non-elected Group I) to more clearly defined that which the Applicant regards as the invention which as can be seen from the following is distinctly different from the mask and pattern techniques of either Hwang or Ando et al.

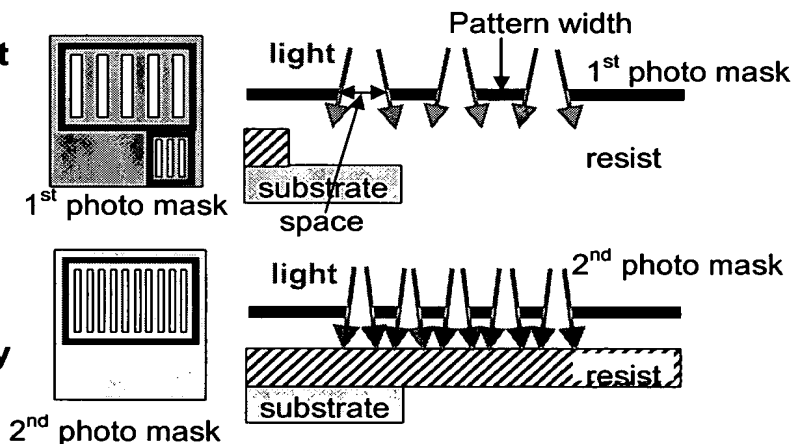
Before discussing the cited prior art references, Applicant would like to point out that the instant invention solves the problem faced by one of ordinary skill in the prior art of forming both rough and fine patterns on a substrate during the fabrication of semiconductor devices. As noted in the specification, at pages 9-12, and illustrated in Figures 10-13, the Applicant has noted that distortion of light as it passes through small openings in photomasks can cause undesirable blurring of the resultant image causing a resolution "error". For a rough pattern, such as those for forming isolation regions, such an "error" may be tolerable, but for forming fine patterns – such as gate electrodes - and alignment with rough patterns - such as isolation regions- this "error" is unsatisfactory. This is illustrated below.

Pattern shift by diffraction of light, i.e., the range of pattern shift is based on the width of pattern and space.



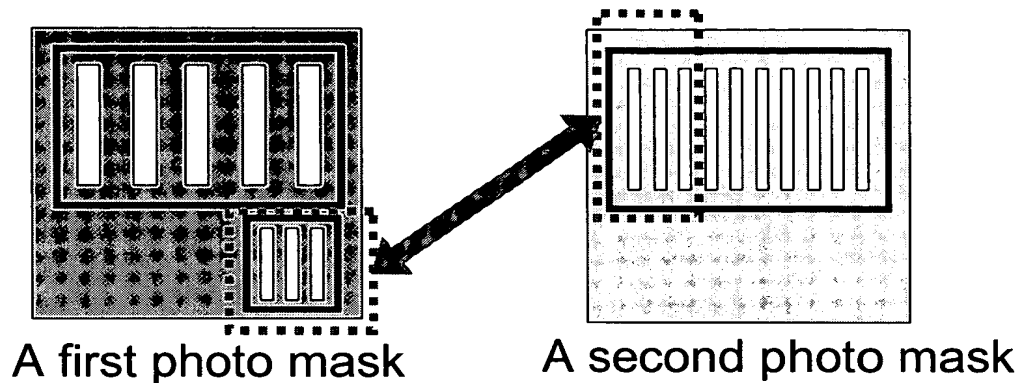
The range of pattern shift is different between 1st rough photo mask and 2nd fine photo mask.

The more narrow the pattern width is, the larger % of an "error" is generated in the resist by the diffraction of light.



The Applicant has resolved this problem with the photomask set of claim 9 and method of aligning of claim 16 such that the difference due to the distortion or diffraction of light at exposure is suppressed by overlaying the second intended pattern (i.e., element 61 in Fig. 4A-4D) in the second photomask with the first on-wafer intended pattern (i.e., element 11 in Fig. 1B), and selecting the width of pattern

and line spacing of a part of the second intended pattern to have the same width of pattern and line spacing as the first alignment mark as illustrated below.



to thereby reduce a shift of the patterns from the actual pattern and the design pattern.

The differences between the presently claimed invention and Hwang and Ando, respectively are set forth below.

As previously discussed in the Amendment filed August 29, 2003, the invention of Hwang relates to an overlay accuracy measurement mark used in measuring an overlay accuracy. Specifically, tetragonal overlaying marks are formed in the layers forming each mask pattern. The invention of Hwang measures the deviation between each mask pattern, as illustrated in Figures 3 and 4 below,

Pattern

FIG.3

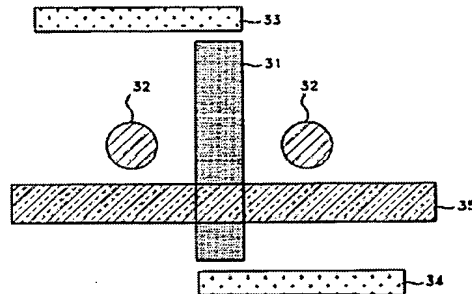
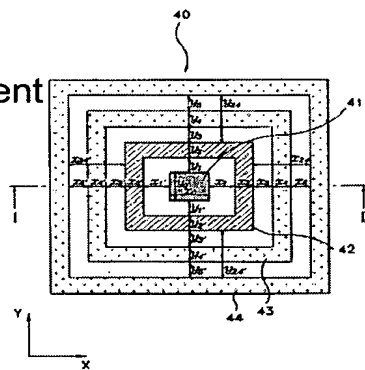


Fig. 4
Measurement
mark



Pattern is different shape from mark.

but there is no dimensional correlation between later intended exposure patterns and the alignment features of the mask used in previous exposures which is utilized during alignment of the later patterns. That is, although the overlay patterns which are to be measured are formed in the mask pattern and are tetragonal, the size/shape of the patterns are different from that of the pattern to be formed.

In contrast, the presently claimed invention is for suppressing the alignment shift discussed above. That is, the first alignment mark has the same line width and spacing as at least a part of the second intended pattern to make the effect of diffraction of light same; thereby, enabling suppression of the alignment shift. Clearly, the presently claimed invention is distinguished from the process and photomasks of Hwang.

With regard to Ando et al., the patentees disclose an invention relating to an exposure system of a mixed apparatus and method using multiple types of exposing

devices during the forming of a single layer mask pattern to achieve a down-sizing while improving through-put. Specifically, a light (400 nm) exposure is performed on the surface of the substrate on which a film of photosensitive material is formed, thereby forming a first rough latent image of the pattern in the photosensitive material. Next, the substrate is conveyed to a plurality of electron beam writing apparatus for forming the fine, repeatable exposed patterns while not effecting throughput.

Thereafter, latent image development is performed after the forming of the mask pattern.

In the presently claimed invention, alignment is performed for a pattern formed by exposure in each layer and development where the first alignment mark of a first photomask has the same line width and spacing as at least a part of the second intended pattern (of the second photomask) to make an effect of diffraction of light same; thereby, the alignment shift (due the effect of diffraction of light) is suppressed when forming the semiconductor device regions at exposure. For this reason, the present invention is also clearly distinguished over Ando et al. who have no appreciation of the claimed relationship between the first alignment mark and the second intended pattern.

To summarize, neither Hwang nor Ando discloses any alignment mark on a first alignment photomask having the same line width and spacing as the second intended pattern on a second photomask which in use enables the calculation of a correction value from the declination between the first alignment mark on the first

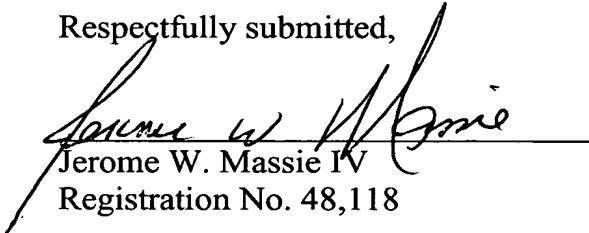
photomask and the first on-wafer (actual) alignment mark formed on the substrate such that when a second intended pattern is to be formed on the substrate (using the second photomask) the declination can be corrected to yield a more precisely formed image of the second intended pattern on the substrate. Such a process makes it possible to suppress the shift of the second image since the effect of diffraction of light is now the same.

In view of the amendments and arguments set forth above, the Applicants respectfully request reconsideration and withdrawal of the pending § 103 rejection.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Lastly, it is noted that a separate Extension of Time Petition (one month) accompanies this response along with an authorization to charge the requisite extension of time fee to Deposit Account No. 19-2380 (740819-568). However, should that petition become separated from this Amendment, then this Amendment should be construed as containing such a petition. Likewise, any overage or shortage in the required payment should be applied to Deposit Account No. 19-2380 (740819-568).

Respectfully submitted,



Jerome W. Massie IV
Registration No. 48,118

NIXON PEABODY LLP
401 9th Street, N.W.
Suite 900
Washington, DC 20004-2128
(202) 585-8000
(202) 585-8080 fax